

tions upon the moon in other phases would show experimentally whether the percentage transmission by glass of the heat from an element of the moon does depend on the altitude of the sun only, or whether the altitude of the earth also has any influence, as, indeed, is suggested by Lord Rosse in a note to his Bakerian Lecture ('Phil. Trans.,' vol. 163, p. 626). It is unfortunate that I have not at present made any other observations on the transmission by glass of the moon's heat.—April 21, 1890.]

IV. "Observations on the Secretion of Bile in a case of Biliary Fistula." By A. W. MAYO ROBSON, F.R.C.S., Hon. Surgeon, Leeds General Infirmary, Lecturer on Practical Surgery at the Yorkshire College, and Examiner in the Victoria University. Communicated by Dr. CLIFFORD ALLBUTT, F.R.S. Received April 3, 1890.*

There are few physiological questions on which so much doubt and disagreement prevail as on that of the secretion and uses of bile, this being especially marked when we come to compare the apparently contradictory observations of various experimenters relating to the action of drugs on the biliary secretion.

As the well known experiments of Dr. Rutherford and Messrs. Prévost and Binet were conducted on the lower animals, it may possibly account for the differences between their observations and those recorded in this paper. From the rarity of cases of biliary fistula in healthy human subjects, the opportunity has rarely occurred for a careful analysis of fresh bile in sufficient quantity, or for a complete analysis of the *whole* twenty-four hours' secretion; and in all previous analyses no notice has been taken of the gall-bladder secretion.

In the following cases, the fistulæ remained open for long periods after the initial operations, the total flow of bile or gall-bladder secretion was carefully collected and accurately measured at different times and for many consecutive hours at a time, and the general good health of the patients was maintained throughout.

Method of Collecting.

The fluid was caught in a light glass flask, into the mouth of which it was guided by means of a celluloid cannula, a substance chosen after several trials with metal ones, on account of its lightness and non-irritating qualities.

* This paper is a revision of that read on January 16, under the title "Observations regarding the Secretion and Uses of Bile" (see p. 129, *supra*).

CASE I.—*Biliary Fistula.*

Mrs. V. B., aged forty-two, was operated on in January, 1888, for the relief of obstruction in the common bile duct. The incision was made over the gall-bladder, which was brought to the surface, relieved of its contents, and opened, the margin being sutured to the edge of the abdominal wound and drained. The patient made a good recovery from the operation; but a biliary fistula persisted, through which was discharged the whole of the bile for fifteen months. In order to ascertain that the whole of the bile secreted escaped through the fistula, and that none entered the bowel, repeated analyses of the urine and fæces were made, but no evidence of the presence of bile was obtained at any time. The fistula was ultimately closed by stitching the gall-bladder to the bowel, and making a communication between them, thus enabling the bile to reach the intestine by another channel. A detailed description of the case will be found in the 'Transactions of the Royal Medical and Chirurgical Society' for 1889.

Influence of Biliary Fistula on Digestion and Nutrition.—During the fifteen months that the fistula was open, the patient's digestion seemed to be unimpaired. The appetite generally was good; there was a craving for acids, such as lemons and pickles, and a dislike to sweet foods, to meat, and to fat. Much fatty matter in her food had a marked effect, producing a sickly feeling, with loss of appetite, and rather more fat than normal was then noticed in the fæces. Her bowels were quite regular without the use of aperients, and the odour of the fæces did not differ from that of healthy motion. Menstruation never occurred during the time the fistula was patent, but, as soon as the bile was again turned into the intestine, the menstrual function became regular and normal.

CASE II.—*Fistula of Gall-bladder not Biliary.*

Mrs. A., aged thirty-two, was operated on in June, 1884, for distended gall-bladder due to gall-stones, with stricture of the cystic duct; the patient made a good recovery from the operation, but a fistula of the gall-bladder persisted. From this opening a constant flow of a clear and somewhat viscid fluid persisted, which was held to be the normal secretion of the gall-bladder, as there was complete obstruction of the cystic duct, and as no bile constituents were found in the fluid at the time of the operation or subsequently.

Analyses of the fluid from this patient were made in October, 1885, and in April, 1887, by Professor de Burgh Birch, of the Yorkshire College (see 'Journal of Physiology,' vol. 8, No. 6), and in March, 1889, by Mr. Fairley, F.C.S., F.R.S.E. In the appended tables will

be found Mr. Fairley's analysis of the secretion for twenty-four hours.

The alleged *Diastatic Action* of bile may possibly be due to the admixture of the secretion from the gall-bladder, or from the mucous glands in the large bile ducts. In the gall-bladder fluid from Case II, Professor Birch found a diastatic ferment, concerning which he reported :— "The secretion cannot be regarded as having any important part to play in digestion, the small diastatic action it possesses on starch being shared by many fluids in the economy upon which it does not confer any special digestive value." ('Journal of Physiology,' vol. 8, No. 6.)

Antiseptic Action.—In Case I, the value of bile as an antiseptic in the intestine could be tested only by the character of the fæces, which, over a period of fifteen months during which no bile entered the bowel, did not by odour or aspect indicate any irregular fermentative process. In Case II, the constant clean appearance of the edge of the fistula suggested to me the idea that it might be due to the antiseptic quality of the gall-bladder fluid ; and the observation, that when collecting the fluid for experimental purposes I could leave the flasks exposed to the air for several days without any apparent change, suggested the same conclusion. Professor Birch, from numerous cultivation experiments, came to the conclusion that its antiseptic properties were slight, the want of change being rather due to the poverty of the fluid in nourishing materials. ('Journal of Physiology,' vol. 8.)

Aperient Action.—In Case I, the bile did not seem to be at all necessary as an intestinal stimulant, for the bowels were quite regular during the whole of the time that no bile was entering the intestines.

Alleged Action of Bile in Promoting Absorption.—In Case I, fat could apparently be digested in quantities sufficient not only to maintain normal nutrition and good health, but to lead to an increase in weight. If taken too freely it seemed to create disturbances of digestion, and to be passed in rather larger quantities than usual in the fæces, as ascertained by careful observation and by separation by means of ether.

Diet.—Details of the daily diet are given in the tables, and may be grouped as follows :—

- | | | |
|-------------------------|---------------|--|
| I. Oct. 24th—27th. | Light diet. | Broth, bread, egg, tea, milk, pudding. |
| II. Oct. 29th—Nov. 4th. | Chicken diet. | Ditto with chicken. |
| III. Nov. 5th—8th. | Potato diet. | Ditto with potato. |
| IV. Nov. 12th. | Meat diet. | Meat, bread, milk, tea. |

Flow of Bile.

The Tables appended show the dates and hours of collection lasting over a period of eight months; the nature and quantity of the diet; and the amount of bile excreted. The Charts also show the dates of administering certain medicines, and their effect or absence of effect on the biliary secretion.

In the drawing up of the charts and tables I have been greatly assisted by my friend Mr. C. W. Biden.

Daily Quantity of Bile Flow.—In Case I, the quantity of bile collected in twenty-four hours on various dates in October, November, and December of 1888, and January, February, March, and April of 1889, varied from 39·53 oz. to 25·86 oz., and averaged 29·98 or nearly 30 oz. In Case II the gall-bladder fluid measured 2·53 oz. in twenty-four hours.

Subtracting this amount from the twenty-four hours' discharge in Case I, we get the average daily flow of bile as 27½ oz.

Diurnal Variation in Flow.—The Tables and Charts show distinctly that more bile is invariably excreted during the day than at night; the difference at times being as much as 5 oz., at others not more than 3 dr.

In the tables and charts which show an hourly collection for over twenty-four hours, it is clearly seen that the excretion of bile is continuous night and day. These measurements were carefully and regularly made by the sisters in charge of the ward, under the supervision of the resident surgical officer, Mr. H. Littlewood, F.R.C.S., and my house surgeons, Mr. B. Moynihan, M.B., F.R.C.S., and Mr. F. Hudson, M.R.C.S., to whom I am much indebted for the great pains they took over so long a period.

The daily quantity does not correspond with the observations of von Wittich and Westphalen, who reported a collection of one pint in the twenty-four hours, with but small variations during ten days.

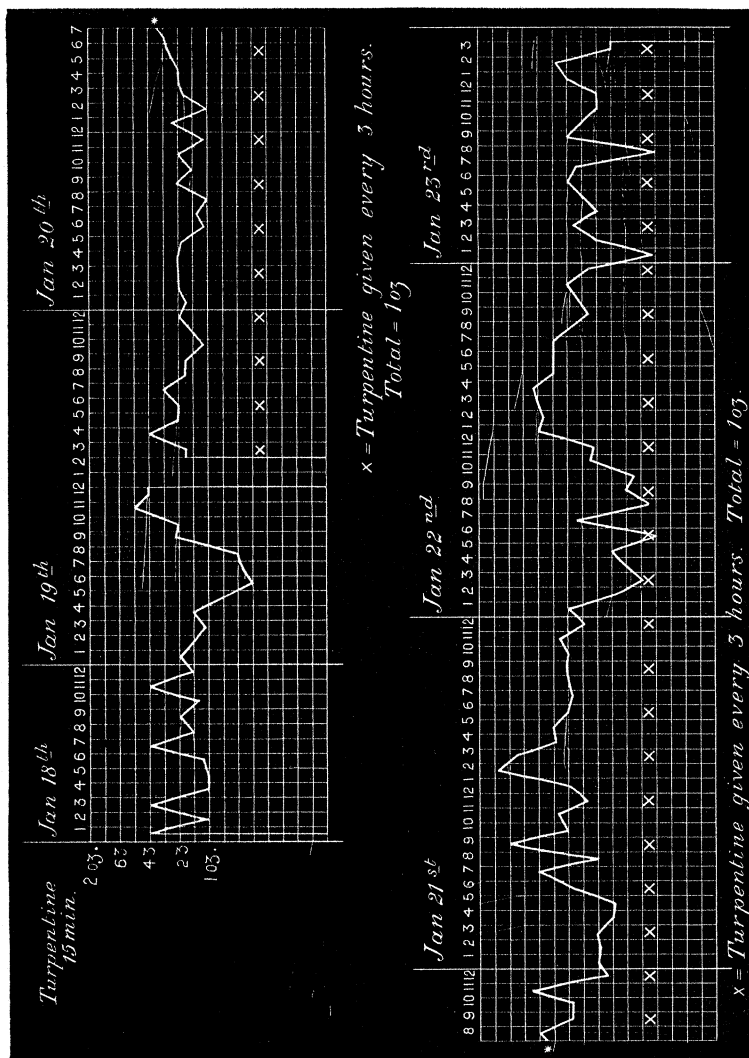
More solids are contained in the bile by night than by day, as is shown by the analysis of the specimens which were examined by Mr. Fairley (see appended Tables).

The quantity of bile discharged is apparently not much influenced by the ingestion of food. The reception of food into the stomach is generally contemporaneous with a marked decline in the flow of bile, lasting for about two hours. The colour of the fresh bile was always green. The violet odour of turpentine was perceived in the bile soon after its administration.

The Effect of Drugs on the Bile Flow.

The observations made on the effect or non-effect of certain drugs on the biliary secretion show results which are at variance

CHART 1.



with the usually accepted views of the action of medicines on the liver.

Calomel.—On Nov. 7th, 1888, 5 gr. of calomel were administered at 7 P.M.; a slight aperient effect followed the next morning, but, on comparing the amount of bile excreted before and after, it was found that for ten hours before the administration of the calomel,

CHART 2.

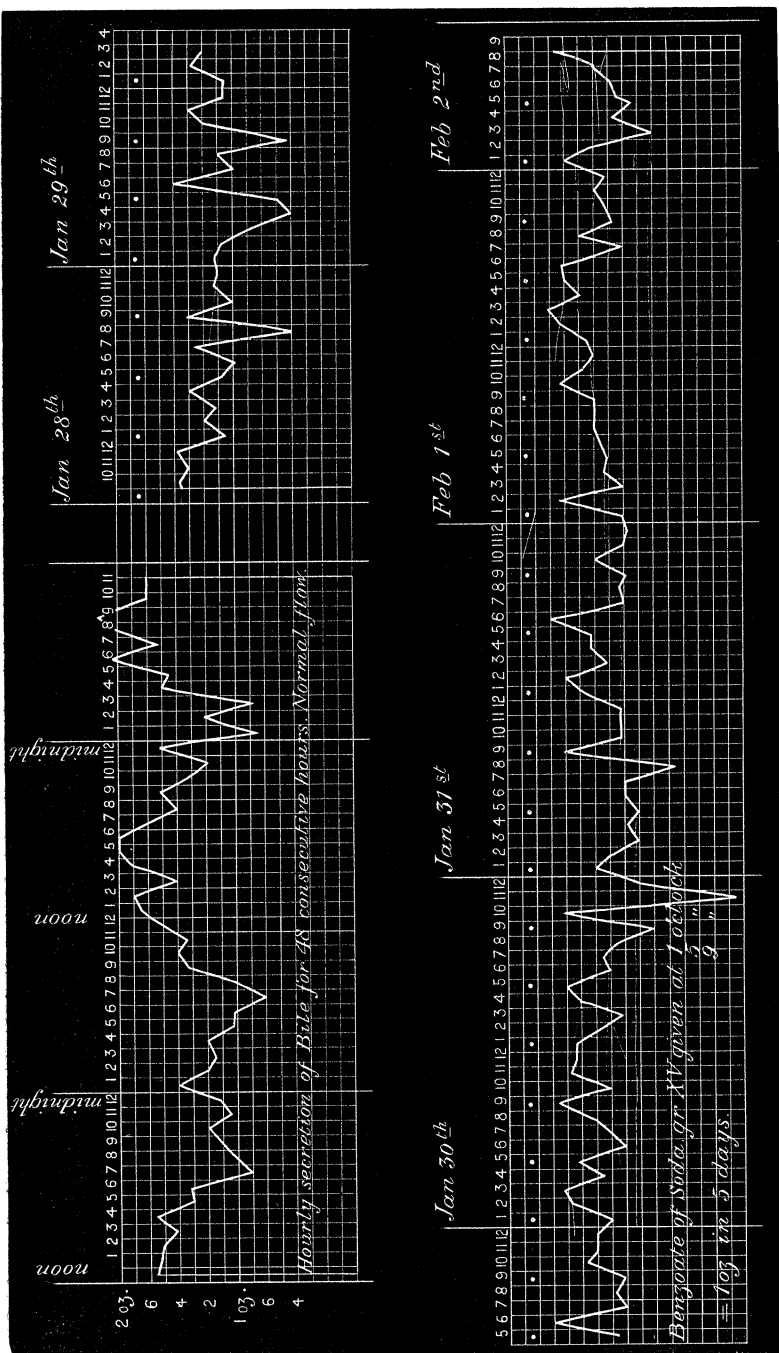
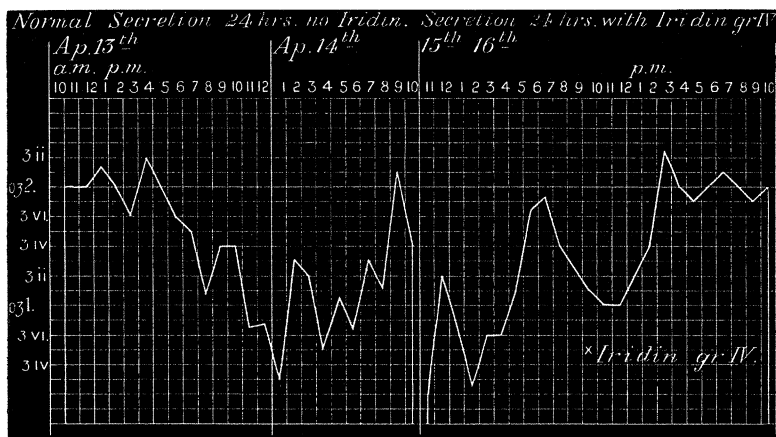


CHART 3.



12 oz. 6 dr. 20 min. of bile were excreted, and that for ten hours subsequent to the administration 10 oz. 4 dr. 30 min. were excreted, *i.e.*, 2 oz. 1 dr. 50 min. less.

Euonymin.—On Nov. 17th 4 gr. of euonymin were given at 11:30 A.M.; for the four hours preceding the administration, 5 oz. 4 dr. 9 min., and during the four hours subsequent to its administration, 5 oz. 1 dr. 8 min., were excreted, *i.e.*, 3 dr. less. This dose was repeated on several occasions with similar results.

Rhubarb.—On Nov. 13th, at 11 A.M., $\frac{1}{2}$ oz. of tincture of rhubarb was administered; during the preceding six hours 7 oz. 3 dr. 23 min. of bile were excreted, and during the six hours subsequent to the administration of the drug, 7 oz. 4 dr. 19 min. were excreted, that is 56 mins. more, in the subsequent than in the preceding six hours. But on comparing the corresponding period of the previous day, when no rhubarb was given, we find that 8 oz. 6 dr. 10 min., or $1\frac{1}{4}$ oz. more, were excreted. Therefore no increased flow of bile can be put down to the action of the rhubarb.

On Nov. 15th, 1 oz. of tincture of rhubarb was given. The figures as seen in the tables again show a diminution compared with the previous day.

Podophyllin was given on one occasion, and no cholagogue effect was noticed.

Carbonate of Soda.—Soda water, aerated, was given, and produced an increased flow. Its ingestion was followed in two hours by a maintained increased flow not succeeded by a marked diminution.

Iridin.—On April 16th, 4 gr. of iridin was followed by a good afternoon rise in the bile flow, but two days later there was a much higher afternoon rise when no drug had been given. On April 19th,

4 gr. of iridin gave an effect not so pronounced, the increased flow being intermittent. Apparently, the action of iridin is to increase the flow temporarily, without augmenting the total quantity in twenty-four hours.

Turpentine.—Messrs. Prévost and Binet state that turpentine and its derivatives promote a notable increase in the excretion. In order to test this, a turpentine capsule containing 15 min. of the oil of turpentine was given every four hours night and day.

On Jan. 18th, no drug given. 27 oz. 6 dr. 35 min. were excreted in twenty-four hours. On Jan. 19th and 20th, during the administration of turpentine capsules, 28 oz. 5 dr. 41 min. were excreted, that is, an increase of 7 dr. During the following twenty-four hours, the capsules being continued, 30 oz. 2 dr. 10 min. were excreted.

During the third period of twenty-four hours with the capsules 26 oz. 57 min. were excreted; and during the fourth twenty-four hours 27 oz. 45 min.

Therefore, although an increase was apparent on the second day, the daily amount of bile discharged in the twenty-four hours was not so much as on many days when no turpentine was being given, as, for instance, on Oct. 27th and 29th, when it was over 30 oz.

Benzoate of Soda.—Messrs. Prévost and Binet state that the administration of benzoate of soda to dogs increased the amount of bile to two or three times the normal. This I do not find to be the result in Case I, as the table and charts appended will show, where no positive increase is seen.

Conclusions.

First.—The bile is probably chiefly excrementitious, and, like the urine, is constantly being formed and cast out.

Secondly.—Though the bile probably assists in the absorption of fats, its presence in the intestine is not necessary for the digestion of such an amount of fat as is capable of supporting life and keeping up nutrition.

Thirdly.—Increase in body weight and good health are quite compatible with the entire absence of bile from the intestines.

Fourthly.—The antiseptic properties of the bile are unimportant.

Fifthly.—Whatever little antiseptic quality bile may have is probably derived from its admixture with the gall-bladder fluid.

Sixthly.—The supposed stimulating effect of the bile on the intestinal walls is not necessary for a regular action of the bowels.

Seventhly.—The quantity of bile excreted in the twenty-four hours, during health in a person of average weight, may vary between 39 oz. 4 dr. and 25 oz. 6 dr., with an average of 30 oz., less the $2\frac{1}{2}$ oz. of fluid secreted by the gall-bladder.

Eighthly.—More bile is excreted during the day than at night, the excess varying between 5 oz. and 3 dr.

Ninthly.—The excretion of bile seems to go on constantly and with great regularity.

Tenthly.—The excretion is apparently not materially influenced by diet.

Eleventhly.—The pigment of fresh human bile is biliverdin.

Twelfthly.—The supposed cholagogues investigated seem to rather diminish than increase the amount of bile excreted.

Mr. Fairley's Analysis.

Analysis of bile drawn from biliary fistula (Mrs. V. B.), collected April 13th, 10 A.M. to 10 P.M., and April 13th—14th, 10 P.M. to 10 A.M., 1889.

Columns I, II, III refer to the whole bile and gall-bladder fluid: Column I, first twelve hours; Column II, second 12 hours; and Column III, the whole fluid collected during twenty-four hours. Column IV gives the composition of the bile calculated without the gall-bladder fluid.

	I.	II.	III.	IV.
	12 hours' bile, 10 A.M. to 10 P.M. April 13.	12 hours' bile, 10 P.M. to 10 A.M. April 13—14.	24 hours' bile, April 13—14.	24 hours' bile, corrected for gall-bladder fluid.
Quantity.....	570 c.c.	370 c.c.	940 c.c.	868 c.c.
Specific gravity ..	1·0085	1·0090	1·0087	1·0086
Reaction.....	Alkaline.			

The bile contains in 1000 parts:—

Water	982·10	981·79	981·98	981·76
Total solids.....	17·90	18·21	18·02	18·24
	<hr/> 1000·00	<hr/> 1000·00	<hr/> 1000·00	<hr/> 1000·00

The solid matter of the bile contains:—

Cholesterin.....	0·44	0·45	0·45	0·45
Fatty matter (free)	0·11	0·12	0·12	0·12
Fat combined (chiefly sodium stearate)	0·90	1·08	0·97	0·97
Sodium glyco- cholate	7·45	7·60	7·51	7·51
Sulphur equal to sodium tauro- cholate	0·087	0·094	0·09	0·09

Organic substances
precipitated by
alcohol, chiefly

	I.	II.	III.	IV.
	12 hours' bile, 10 A.M. to 10 P.M. April 13.	12 hours' bile, 10 P.M. to 10 A.M. April 13—14.	24 hours' bile, April 13—14.	24 hours' bile, corrected for gall-bladder fluid.
mucus and epi- thelium	1.31	1.29	1.30	0.85
Chlorides equal to sodium chlo- ride	5.08	4.91	5.01	4.95
Carbonates and phosphates of sodium, potas- sium, lime, magnesia, and iron	2.52	2.66	2.57	2.54
Copper .....	..	minute trace	..	trace
Silica .....	..	trace	..	trace
Sulphates } .....	..	none	..	none
Urea }	..			
Sugar }	..			

The solid matter of the bile gave on ignition :—

Ash per 1000 parts	8.15	8.68	8.36	8.34
--------------------	------	------	------	------

The above analysis of the bile was confirmed by a further quantitative analysis of the bile taken five days later.

The average quantity of bile as ascertained by observations extending over eight months was 30 ounces (very nearly 862 c.c.) during twenty-four hours.

Analysis of Fluid from the Gall-bladder (collected during 24 hours.
Mrs. A.). Received April 29, 1889.

Quantity	72 c.c.
Specific gravity	1.0095
Reaction	Alkaline.

The fluid contains in 1000 parts :—

Water	984.64
Total solids*	15.36

The solid matter contains :—

Organic matter, chiefly mucin with trace of albumen	6.72
Chlorides equal to sodium chloride...	5.73
Sodium carbonate	2.20
Other salts, containing phosphates, potassium salts, &c.	0.71

* The solid matter was carefully dried until its weight was constant, and on ignition gave 8.64 parts of ash.

Schedule showing Amount of Variation in Flow over a Period due to the Drug.

Drug.	Duration of observing period.	Difference in flow from		Actual flow during period stated with drug.	Date.
		The preceding period same day.	Contemporaneous period previous day.		
Calomel.....	hrs. 10	oz. dr. min. -2 1 50	oz. dr. min. +1 0 20	oz. dr. min. 10 4 30	Nov. 7
Rhubarb.....	6	+0 0 56	-1 1 51	7 4 19	13
".....	6	+0 4 51	-2 6 46	7 3 24	15
Euonymin.....	4	-0 3 1	-0 2 12	5 1 8	17
Turpentine.....	24	..	+0 7 6	28 5 41	Jan. 19
".....	"	..	+1 4 29	30 2 10	20
".....	"	..	-4 1 13	26 0 57	21
".....	"	..	+0 7 48	27 0 45	22
".....	"	..	-1 4 30	26 1 5	28
Soda benzoate	"	..	+3 5 10	29 6 15	29
".....	"	..	-3 3 10	26 3 5	30
".....	"	..	+2 1 15	28 4 20	31
".....	"	..	+2 0 25	30 4 45	Feb. 1

Minus = decrease of "so much," possibly due to drug.

Plus = increase of "so much," possibly due to drug.

Mrs. V. B. Age 42. Daily Excretion of Bile.

<i>Oct. 24—</i>		oz.	dr.	min.
12—1 P.M.	Fish, 6 oz.; pudding	1	4	59
1—2	.. ..	1	4	30
2—3	.. ..	1	1	40
3—4	.. ..	1	1	40
4—5	Tea, 14 oz.; bread, 5½ oz.; egg, 1.....	1	1	0
5—6	.. ..		7	0
6—7	.. ..	1	3	0
7—8	Milk, 1 pint	1	2	0
8—9	.. ..	1	2	46
9—10	.. ..	1	2	0
10 P.M.—7 A.M.	Milk, 1 pint	6	5	0
7—8	Tea, 16 oz.; bread, 5½ oz.	1	2	30
8—9	.. ..	1	4	0
9—10	.. ..	1	2	40
10—11	Beef tea, 1 pint	1	3	30
11—12 noon	.. ..	1	2	0
Total quantity excreted in 24 hours		oz.	dr.	min.
		26	2	15
From 10 P.M. to 10 A.M.		10	6	10
,, 10 A.M. to 10 P.M.		15	4	5
<i>Oct. 25—</i>				
10—11	Beef tea, 1 pint	1	3	30
11—12 noon	.. ..	1	2	0
12—1	.. ..	1	1	45
1—2	.. ..	1	1	40
2—3	.. ..	1	2	0
3—4	Tea, 10 oz.; bread, 6 oz.; egg, 1.....	1	0	30
4—5	.. ..	1	1	0
5—6	.. ..	1	3	0
6—7	Chicken broth, 12 oz.	1	4	0
7—8	.. ..	1	1	0
8—9	.. ..	1	3	0
9—10	Milk, 1 pint		7	0
10—5 A.M.	.. ..	7	5	0
5—6	.. ..	1	1	30
6—7	.. ..	1	0	30
7—8	Tea, 10 oz.; bread, 4½ oz.	1	2	0
8—9	.. ..	1	3	0
9—10	.. ..	1	4	0
10 A.M. to 10 P.M.		oz.	dr.	min.
		14	6	25
10 P.M. to 10 A.M.		14	0	0
		28	6	25

Mrs. V. B. Age 42. Daily Excretion of Bile.

<i>Oct. 26—</i>			oz.	dr.	min.
10—11	..	..	1	2	25
11—12 noon	..	..	1	4	0
12—1	Broth, 18 oz.; pudding, 11 oz.....		1	0	37
1—2	Bread, 1 oz.		1	3	30
2—3	..	..	1	2	0
3—4	..	..	1	4	0
4—5	Tea, 16 oz.; bread, 5 oz.; egg, 1.....		1	0	35
5—6	..	..	1	4	0
6—7	..	..	1	0	40
7—8	Milk, 1 pint		6	50	
8—9	..	..	1	2	15
9—10	..	..	1	2	0
10—5 A.M.	Milk, 1 pint		7	6	0
5—6	..	..	1	2	0
6—7	Tea, 10 oz.; bread, 4½ oz.		1	0	0
7—8	..	..	1	0	0
8—9	..	..	1	5	0
9—10	..	..	1	4	35
			oz.	dr.	min.
10 A.M. to 10 P.M.			15	0	52
10 P.M. to 10 A.M.			14	1	35
			29	2	27
<i>Oct. 27—</i>					
10—11	..	..	1	4	35
11—12 noon	Broth, 17 oz.; pudding, 7½ oz.		1	4	0
12—1	..	..	1	0	0
1—2	..	..	1	0	0
2—3	..	..	1	2	10
3—4	..	..	1	3	33
4—5	Tea, 17 oz.; bread, 5 oz.; egg, 1.....		1	2	0
5—6	..	..	1	4	0
6—7	..	..	1	2	0
7—8	Milk, 19 oz.		1	2	50
8—9	..	..	1	0	0
9—10	..	..	1	2	0
10—5 A.M.	..	..	7	6	0
5—6	..	..	1	0	0
6—7	..	..	1	2	55
7—8	Tea, 16 oz.; bread, 5½ oz.; milk, 10 oz.		1	4	0
8—9	..	..	1	4	0
9—10	..	..	1	5	0
10—11	..	..	1	2	50
11—12	..	..	1	4	45
			oz.	dr.	min.
10 A.M. to 10 P.M.			15	3	8
10 P.M. to 10 A.M.			14	5	55
			30	1	3

Mrs. V. B. Age 42. Daily Excretion of Bile.

Oct. 29—		oz.	dr.	min.
7—8	Tea, 10 oz.	1	2	45
8—9	Bread, 5 oz.	2	0	0
9—10	Milk, 9 oz.	1	5	40
10—11	.. ..	1	3	0
11—12 noon	.. ..	1	1	0
12—1	Chicken, 7 oz.; pudding, 6 oz.	1	5	11
1—2	.. ..	1	4	0
2—3	.. ..	1	4	0
3—4	.. ..	1	3	0
4—5	Tea, 15 oz.; bread, 5½ oz.; egg, 1	1	2	50
5—6	.. ..	1	2	0
6—7	Milk, 12 oz.	1	0	57
7—8	.. ..	1	3	30
8—9	.. ..	1	3	57
9—10	Milk, 10 oz.	1	1	25
10—5 A.M.	Milk, 18 oz.	8	1	50
5—6	.. ..	1	1	50
6—7	.. ..	1	0	40
7—8	Tea, 15 oz.; bread, 5½ oz.	1	0	35
8—9	Bread, 5½ oz.	1	4	40
9—10	.. ..	1	2	0
10 A.M. to 10 P.M.		16	2	50
10 P.M. to 10 A.M.		14	3	35
		30	6	25
Oct. 30—		oz.	dr.	min.
10—11	.. ..	1	3	30
11—12 noon	Chicken, 6 oz.	1	3	25
12—1	.. ..	1	2	0
1—2	.. ..	1	3	10
2—3	.. ..		
3—4	Tea, 17 oz.; bread	1	0	42
4—5	.. ..	1	4	0
5—6	.. ..	1	6	46
6—7	Milk, 11 oz.	1	2	0
7—8	.. ..	1	1	1
8—9	.. ..	1	2	0
9—10	.. ..	1	2	40
10—5	Milk, 1 pint	7	6	6
5—6	.. ..		7	50
6—7	.. ..	1	2	0
7—8	Tea, 15 oz.; bread, 5½ oz.	1	3	0
8—9	.. ..	1	5	1
9—10	Milk, 12 oz.	1	4	0
10 A.M. to 10 P.M.		14	7	14
10 P.M. to 10 A.M.		14	3	57
		29	3	11

Mrs. V. B. Age 42. Daily Excretion of Bile.

<i>Oct. 31—</i>			oz.	dr.	min.
10—11	.. .. .	.. .. .	1	4	0
11—12 noon.	.. .. .	.. .. .	1	1	20
12—1	Chicken, 6 oz.; pudding, 11 oz.; milk, 8 oz.		1	2	25
1—2	.. .. .	.. .. .	1	2	35
2—3	.. .. .	.. .. .	1	3	0
3—4	Tea, 10 oz.; bread, 5 oz.		1	3	0
4—5	.. .. .	.. .. .	1	2	0
5—6	.. .. .	.. .. .	1	1	20
6—7	Milk, 18 oz.		1	3	25
7—8	.. .. .	.. .. .		7	32
8—9	.. .. .	.. .. .	1	0	17
9—10	.. .. .	.. .. .		7	50
10—5 A.M.	Milk, 1 pint		6	6	0
5—6	.. .. .	.. .. .	1	3	0
6—7	.. .. .	.. .. .	1	4	0
7—8	Tea, 15 oz.; bread, 5½ oz.		1	3	0
8—9	.. .. .	.. .. .	1	3	50
9—10	.. .. .	.. .. .	1	3	45
			oz. dr. min.		
10 A.M. to 10 P.M.			14	6	44
10 P.M. to 10 A.M.			13	7	35
			28	6	19
<i>Nov. 1—</i>					
10—11	Milk, 12 oz.		1	0	45
11—12 noon.	.. .. .	.. .. .	1	2	55
12—1	Chicken, 12 oz.; pudding, 9 oz.		1	5	0
1—2	.. .. .	.. .. .	1	2	35
2—3	.. .. .	.. .. .	1	4	0
3—4	Tea, 20 oz.; bread, 5½ oz.; egg, 1		1	3	0
4—5	.. .. .	.. .. .	1	0	0
5—6	.. .. .	.. .. .	1	3	0
6—7	Milk, 15 oz.		1	1	10
7—8	.. .. .	.. .. .	1	4	0
8—9	.. .. .	.. .. .	1	0	59
9—10	.. .. .	.. .. .	1	1	25
10—5 A.M.	.. .. .	.. .. .	7	4	30
5—6	.. .. .	.. .. .	1	1	0
6—7	.. .. .	.. .. .	1	0	30
7—8	Tea, 20 oz.; bread, 6½ oz.			7	0
8—9	.. .. .	.. .. .	1	5	10
9—10	.. .. .	.. .. .	1	4	0
			oz. dr. min.		
10 A.M. to 10 P.M.			15	4	50
10 P.M. to 10 A.M.			13	6	10
			29	3	0

Mrs. V. B. Age 42. Daily Excretion of Bile.

<i>Nov. 2—</i>			oz.	dr.	min.
10—11	Milk, 20 oz. ..	..	1	5	10
11—12 noon	Chicken and bread, 6 oz.; pudding, 11 oz.	..	1	2	40
12—1	..	..	1	1	0
1—2	..	..	1	6	0
2—3	..	..	1	2	19
3—4	..	..	1	1	2
4—5	Tea, 9 oz. ....	..	1	4	0
5—6	..	..	1	4	0
6—7	Milk, 15 oz. ....	..	1	2	3
7—8	..	..	..	5	2
8—9	..	..	1	0	40
9—10	..	..	..	7	35
10—5 A.M.	..	..	6	4	0
5—6	..	..	1	1	10
6—7	..	..	..	7	39
7—8	..	..	1	0	35
8—9	..	..	1	4	17
9—10	..	..	1	4	50
			oz. dr. min.		
10 A.M. to 10 P.M.			15	1	31
10 P.M. to 10 A.M.			12	6	31
			28	0	2
<i>Nov. 3—</i>					
10—11	Milk, 9 oz. ....	..	1	1	0
11—12 noon	..	..	1	1	15
12—1	Chicken, 6½ oz.; pudding, 6½ oz. ....	..	1	1	15
1—2	..	..	1	7	50
2—3	..	..	1	0	0
3—4	Tea, 15 oz.; bread, 6 oz.; egg, 1.....	..	1	1	30
4—5	..	..	1	4	0
5—6	..	..	1	4	0
6—7	Milk, 9 oz. ....	..	..	6	0
7—8	Eunonymin, gr. jss., at 7 P.M. ....	..	1	3	10
8—9	..	..	1	2	0
9—10	..	..	1	1	32
10—5 A.M.	..	..	8	1	0
5—6	..	..	1	1	40
6—7	..	..	1	1	40
7—8	Tea, 11 oz.; bread, 4 oz. ....	..	1	0	0
8—9	..	..	1	6	0
9—10	..	..	1	4	0
			oz. dr. min.		
10 A.M. to 10 P.M.			15	1	32
10 P.M. to 10 A.M.			14	6	20
			29	7	52

Mrs. V. B. Age 42. Daily Excretion of Bile.

Nov. 4—		oz.	dr.	min.
10—11	Milk, 9 oz.	1	2	0
11—12 noon	.. ..	1	1	0
12—1	Chicken, 6 oz.; pudding, 9 oz.; milk, 9 oz.	1	2	0
1—2	.. ..	1	5	0
2—3	.. ..	1	4	45
3—4	Bread, 3 oz.; tea, 16 oz.; egg, 1	0	6	0
4—5	.. ..	1	1	0
5—6	.. ..	1	4	0
6—7	.. ..	1	0	0
7—8	.. ..	1	2	0
8—9	.. ..	1	1	0
9—10	Euonymin, gr. iij, at 10.30 P.M.	1	0	15
10—5 A.M.	Milk, 1 pint	7	0	10
5—6	.. ..	1	0	36
6—7	.. ..	1	3	5
7—8	Tea, 10 oz.; bread, 6 oz.	1	0	45
8—9	.. ..	1	0	0
9—10	Milk, 9 oz.	1	0	0
		oz.	dr.	min.
10 A.M. to 10 P.M.		14	5	0
10 P.M. to 10 A.M.		12	4	36
		27	1	36
Nov. 5—				
10—11	.. ..	1	2	0
11—12 noon	.. ..	1	0	40
12—1	Chicken and potato, 8 oz., pudding	1	4	0
1—2	.. ..	1	2	25
2—3	.. ..	1	1	40
3—4	Tea, 16 oz.; bread, 6 oz.; egg, 1	1	1	15
4—5	.. ..	1	3	0
5—6	.. ..	1	2	50
6—7	Milk, 10 oz.	1	1	0
7—8	.. ..	1	0	25
8—9	.. ..	0	7	0
9—10	.. ..	1	6	55
10—5 A.M.	Milk, 1 pint	7	0	0
5—6	.. ..	1	0	0
6—7	.. ..	0	7	0
7—8	Tea, 16 oz.; bread, 4½ oz.	1	3	10
8—9	.. ..	1	2	0
9—10	.. ..	1	4	0
		oz.	dr.	min.
10 A.M. to 10 P.M.		15	1	10
10 P.M. to 10 A.M.		13	0	10
		28	1	20

Mrs. V. B. Age 42. Daily Excretion of Bile.

Nov. 6—		oz.	dr.	min.
10—11	Milk, 8 oz.....	1	4	20
11—12 noon	Chicken and potato, 7 oz.; pudding, 8 oz.	1	2	25
12—1	.. .. .	1	4	0
1—2	.. .. .	1	1	50
2—3	.. .. .	1	1	0
3—4	Tea, 10 oz.; bread, 6 oz.	1	1	10
4—5	.. .. .	1	0	0
5—6	.. .. .	1	3	0
6—7	Milk, 10 oz.	1	2	0
7—8	.. .. .	1	3	0
8—9	.. .. .	1	0	0
9—10	.. .. .	1	0	5
10—5 A.M.	Milk, 1 pint	6	1	5
5—6	.. .. .	0	1	30
6—7	.. .. .	0	3	0
7—8	Tea, 11 oz.; bread, 4½ oz.	1	1	30
8—9	.. .. .	1	5	0
9—10	Milk, 8 oz.....	1	4	0
10 A.M. to 10 P.M.		14	6	50
10 P.M. to 10 A.M.		11	0	5
		25	6	55

Nov. 7—				
10—11	.. .. .	1	2	0
11—12 noon	Chicken and potato, 8 oz.	1	0	0
12—1	.. .. .	1	2	0
1—2	.. .. .	1	2	0
2—3	.. .. .	1	2	20
3—4	Tea, 16 oz.; bread, 6 oz.; egg, 1	1	2	0
4—5	.. .. .	1	2	10
5—6	.. .. .	1	3	10
6—7	Milk, 17 oz.	1	2	40
7—8	Calomel, gr. v	1	0	0
8—9	.. .. .	1	0	0
9—10	.. .. .	0	6	0
10—5 A.M.	.. .. .	7	6	30
5—6	.. .. .	1	0	0
6—7	.. .. .	0	6	35
7—8	Tea, 16 oz.; bread, 4½ oz.	0	7	0
8—9	.. .. .	1	2	0
9—10	Milk, 10 oz.	1	3	0
10 A.M. to 10 P.M.		14	0	20
10 P.M. to 10 A.M.		13	1	5
		27	1	25
At 7 P.M. calomel, gr. v, 10 hours <i>before</i> ..		12	6	20
10 hours <i>after</i>		10	4	30
Corresponding 10 hours <i>after</i> on previous day		9	4	10

Mrs. V. B. Age 42. Daily Excretion of Bile.

Nov. 8—		oz.	dr.	min.
10—11	.. ..	1	2	40
11—12 noon	Chicken and potato, 8 oz.; milk, 8 oz.; gravy, 1 oz.	1	0	0
12—1	.. ..	1	2	0
1—2	.. ..	1	1	30
2—3	.. ..	1	4	0
3—4	Tea, 19 oz.; bread, 2½ oz.; egg, 1	1	1	25
4—5	.. ..	1	1	55
5—6	.. ..	1	3	20
6—7	.. ..	1	2	0
7—8	.. ..	1	4	0
8—9	.. ..	1	1	0
9—10	.. ..	1	0	20
10—5 A.M.	Milk, 16 oz.	6	6	0
<div> 10 A.M. to 10 P.M. 15 0 10 10 P.M. to 10 A.M. 12 6 25 <hr/> 27 6 35 </div>				
Nov. 9—				
5—6	.. ..	1	1	50
6—7	.. ..	1	2	0
7—8	Tea, 19 oz.; bread, 4½ oz.	1	1	55
8—9	.. ..	1	3	40
9—10	Milk, 10 oz.	0	7	0
10—11	.. ..	1	1	0
11—12	Chicken and potato, 8 oz.; pudding, 8 oz.	1	1	15
12—1	.. ..	1	1	45
1—2	.. ..	1	2	0
2—3	.. ..	1	1	35
3—4	Tea, 12 oz.; bread, 4½ oz.	1	4	0
4—5	.. ..		5	0
5—6	.. ..	1	1	25
6—7	.. ..	1	1	5
7—8	.. ..	1	0	0
8—9	.. ..	1	2	0
<div> oz. dr. min. 9 A.M. to 9 P.M. 12 5 5 </div>				

Mrs. V. B. Age 42. Daily Excretion of Bile.

Nov. 12—		oz.	dr.	min.
9—12 noon	Milk, 1 pint	3	4	0
12—1	Meat, &c., 16 oz.; water, 10 oz.	1	3	2
1—2	.. ..	1	2	2
2—3	.. ..	1	3	1
3—4	Tea, 20 oz.; bread, 2 oz.	1	4	2
4—5	.. ..	1	6	3
5—6	.. ..	1	6	2
6—7	.. ..	1	4	1
7—8	.. ..	1	4	2
8—9	.. ..	1	2	1
		oz.	dr.	min.
9 A.M. to 9 P.M.		16	6	16
Nov. 13—				
5—6 A.M.	.. ..	1	3	0
6—7	.. ..	1	0	10
7—8	.. ..		7	5
8—9	Tea, 1 pint; bread, 4 oz.	1	4	4
9—10	.. ..	1	4	3
10—11	Milk, 10 oz.	1	1	1
11—12	Tinct. rhei, ʒss.		6	5
12—1	Meat, &c., 16 oz.; water, 10 oz.	1	2	1
1—2	.. ..	1	0	2
2—3	.. ..	1	0	0
3—4	.. ..	1	6	3
4—5	Tea, 1 pint; bread, 1 oz.	1	6	8
5—6	.. ..	1	0	8
6—7	.. ..	1	2	6
7—8	Milk, 15 oz.; bread, 2 oz.	1	0	0
8—9	.. ..	1	1	8
9—10	.. ..	1	2	0
		oz.	dr.	min.
5 A.M. to 11 A.M.		7	3	23
At 11, tinct. rhei, ʒss.				
11 A.M. to 5 P.M.		7	4	19
9 A.M. to 9 P.M.		14	4	45
(Cf. 9th and 12th November and 14th and 15th November.)				
10 A.M. to 10 P.M.		14	2	42
10 P.M. to 10 A.M., not measured.				
Nov. 14—		oz.	dr.	min.
6 A.M. to 6 P.M.		16	6	37
9 A.M. to 9 P.M.		17	7	45
11 A.M. to 5 P.M.		9	6	11
12 A.M. to 6 P.M.		10	2	10

Mrs. V. B. Age 42. Daily Excretion of Bile.

<i>Nov. 15—</i>				oz.	dr.	min.
6—7 A.M.	..	..	..	1	2	0
7—8	..	..	..	1	6	4
8—9	Tea, 20 oz.; bread, 2 oz.	..	..	1	0	8
9—10	..	..	..	1	0	5
10—11	Milk, 10 oz. ....	..	..	1	6	10
11—12	Tinct. rhei, ʒj .....	..	..	1	0	6
12—1	Meat, &c., 12 oz.; water, 10 oz. ....	..	..	1	2	4
1—2	..	..	..	1	2	0
2—3	..	..	..	1	4	2
3—4	..	..	..	1	2	8
4—5	Tea, 20 oz.; bread, 1½ oz. ....	..	..	1	0	10
5—6	..	..	..	1	1	0
6—7	..	..	..	1	7	3
7—8	Milk, 15 oz.; bread, 1 oz. ....	..	..	1	5	4
8—9	..	..	..	1	0	5
9—10	..	..	..	1	1	0
At 11½ Tinct. rhei, ʒj.				oz.	dr.	min.
6 A.M. to 12				6	6	33
12 to 6 P.M.				7	3	24
9 A.M. to 9 P.M.				15	5	57
<i>Nov. 16—</i>						
6—7 A.M.	..	..	..	1	2	0
7—8	..	..	..	1	2	8
8—9	Tea, 20 oz.; bread, 6 oz. ....	..	..	1	4	6
9—10	..	..	..	1	3	2
10—11	Milk, 10 oz. ....	..	..	
11—12	..	..	..	2	7	3
12—1	Meat, 16 oz. ....	..	..	1	2	5
1—2	..	..	..	1	4	3
2—3	Water, 10 oz. ....	..	..	1	4	7
3—4	..	..	..	1	1	5
4—5	Tea, 20 oz.; bread, 3 oz. ....	..	..	1	4	3
5—6	..	..	..	1	5	4
6—7	..	..	..	1	0	3
7—8	Milk, 15 oz.; bread, 2 oz. ....	..	..		7	5
8—9	..	..	..	1	1	7
				oz.	dr.	min.
6 A.M. to 6 P.M.				16	6	46

Mrs. V. B. Age 42. Daily Excretion of Bile.

<i>Nov. 17—</i>				oz.	dr.	min.
7—8	..	..	..	1	2	4
8—9	Tea, 20 oz. ; bread, 7 oz.....			1	6	1
9—10	..	..	..	1	2	1
10—11	Milk, 10 oz.			1	2	3
11—12	Euonymin, gr. iv			1	3	4
12—1	Meat, &c., 16 oz. ; water, 10 oz.			1	2	5
1—2	..	..	..	1	2	0
2—3	..	..	..	1	3	0
3—4	..	..	..	1	2	3
4—5	Tea, 20 oz. ; bread, 2 oz.			1	3	5
5—6	..	..	..	1	4	7
6—7	..	..	..	2	2	0
7—8	Milk, 15 oz. ; bread, 2 oz.			1	1	1
8—9	..	..	..	1	0	3
9—10	..	..	..	1	3	0
				oz.	dr.	min.
7 A.M. to 11 A.M.				5	4	9
At 11½, euonymin, gr. iv.						
12 to 4 P.M.				5	1	8
10 A.M. to 10 P.M.				16	3	21

Hour of the day.	Jan. 18 and 19.*	Jan. 19 and 20.	Jan. 20 and 21.	Jan. 21 and 22.	Jan. 22 and 23.
Noon. 12-1	oz. dr. min. 1 4 0	oz. dr. min.	oz. dr. min.	oz. dr. min.	oz. dr. min.
1-2	1 0 0	.. ..	.. ..	.. ..	.. ..
2-3	1 4 0	.. ..	.. ..	.. ..	.. ..
3-4	1 0 0	+1 4 0	+1 2 0	+1 2 41	1 4 10
4-5	1 0 0	1 2 0	1 2 10	1 3 0	1 3 0
5-6	1 0 25	+1 3 0	+1 3 10	1 2 40	+1 3 0
6-7	1 1 4 0	1 1 30	1 4 0	1 2 0	1 2 0
7-8	1 1 0	1 1 30	1 1 40	+1 2 6	1 0 40
8-9	1 2 0	1 1 40	1 1 40	1 2 0	1 1 20
9-10	1 0 40	+1 0 25	+1 1 40	1 2 0	1 2 0
10-11	1 4 0	1 1 0	1 4 35	1 2 40	1 2 0
11-12	1 1 0	1 1 50	7 0	+1 1 0	+1 0 45
	Jan. 19.	Jan. 20.	Jan. 21.	Jan. 22.	Jan. 23.
Midnt. 12-1	1 2 0	+1 1 30	+1 0 0	1 2 0	4 0
1-2	1 1 0	1 2 0	1 0 0	1 6 45	1 0 0
2-3	1 0 25	1 2 0	1 0 0	+ 4 55	+1 1 30
3-4	1 1 0	+1 2 0	+ 7 0	6 25	1 0 0
4-5	1 7 0	1 1 50	6 55	6 55	1 1 0
5-6	5 0	1 0 25	1 1 45	+ 4 0	+1 2 0
6-7	5 45	+1 0 50	+1 4 0	1 1 30	1 1 30
7-8	6 0	1 0 0	1 0 0	1 4 20	1 4 0
8-9	1 2 20	1 2 6	1 6 0	+ 6 0	+1 2 0
9-10	1 2 0	+1 1 0	+1 2 0	5 30	1 1 0
10-11	1 5 0	1 2 0	1 2 42	1 0 30	1 0 0
11-12	1 4 0	1 0 25	1 0 40	+1 0 20	+1 0 0
Noon. 12-1	.. ..	+1 2 40	+1 2 0	1 4 0	1 2 0
1-2	.. ..	1 0 0	1 6 43	1 3 40	1 2 50
2-3	.. ..	1 1 40	1 5 30	+1 4 0	+ 7 0
Total amount of bile } in 24 hours	27 6 35	28 5 41	30 2 10	26 0 57	27 0 45

* No turpentine given these 24 hours.

† Means 15 min. of turpentine given at beginning of hours.

Hour of the day.	Jan. 28 and 29.	Jan. 29 and 30.	Jan. 30 and 31.	Jan. 31 and Feb. 1.	Feb. 1 and 2.
9-10	oz. dr. min. *1 3 30	oz. dr. min. *1 2 0	oz. dr. min. *1 1 5	oz. dr. min. *1 0 10	oz. dr. min. *1 4 15
10-11	1 3 0	1 3 0	1 3 50	1 0 20	1 2 40
11-12	1 3 50	1 0 40	1 3 30	1 0 20	1 2 0
Noon. 12-1	1 0 40	1 0 40	1 3 15	1 2 40	1 2 35
1-2	*1 2 0	*1 2 45	*1 1 45	*1 4 0	*1 4 10
2-3	1 1 5	1 2 5	1 0 10	1 1 10	1 5 5
3-4	1 3 0	Not collected (say, 1 0 0)	1 3 0	1 2 25	1 3 0
4-5	1 0 50	1 0 40	1 4 0	1 2 25	1 4 0
5-6	*1 0 0	*1 5 0	*1 1 0	*1 5 5	*1 4 25
6-7	1 2 30	1 0 0	1 1 30	1 0 0	1 0 0
7-8	4 0	1 0 45	1 0 40	1 0 25	1 3 0
8-9	1 3 10	1 0 20	6 0	1 0 0	1 0 40
9-10	*1 0 0	*1 2 40	*1 4 15	*1 2 0	*1 1 20
10-11	1 1 25	1 2 0	25	1 0 0	1 2 0
11-12	1 1 0	1 2 0	7 0	1 7 50	1 1 15
	Jan. 29.	Jan. 30.	Jan. 31.	Feb. 1.	Feb. 2.
Midnt. 12-1	1 1 20	1 1 0	1 2 0	1 0 0	1 4 0
1-2	*1 0 45	*1 3 40	*1 1 0	*1 5 20	*1 2 0
2-3	6 45	1 4 20	7 0	1 0 0	6 0
3-4	4 0	1 1 30	7 45	1 1 20	1 0 45
4-5	5 0	1 3 20	7 0	1 1 20	7 20
5-6	*1 4 0	*1 0 0	*1 0 0	*1 1 30	*1 0 35
6-7	7 50	1 1 0	1 0 0	1 2 0	1 1 0
7-8	1 1 5	1 2 10	4 45	1 2 0	1 2 0
8-9	4 20	1 4 40	1 4 10	1 2 0	1 4 40
Total amount of bile in 24 hours }	26 1 5	29 6 15	26 3 5	28 4 20	30 4 45

* Benzoate of soda, gr. xv, administered.

Hourly Secretion of Bile for 48 Consecutive Hours. Normal.

<i>April 10—</i>	oz.	dr.	min.	<i>April 11—</i>	oz.	dr.	min.
11—12 noon.	1	5	30	11—12 noon.	1	5	5
12—1 P.M.	1	5	20	12—1.30 P.M.	2	4	30
1—2	1	5	25	1.30—2	1	1	5
2—3	1	4	15	2—3	1	4	0
3—4	1	5	30	3—4	1	7	10
4—5	1	3	0	4—5	2	0	0
5—6	1	3	10	5—6	2	0	0
6—7		7	0	6—7	1	6	0
7—8	1	0	0	7—8	1	4	0
8—9	1	1	0	8—9	1	5	10
9—10	1	2	0	9—10	1	3	10
10—11	1	0	35	10—11	1	2	0
11—12	1	1	10	11—12	1	5	20
Midnt. 12—1	1	4	0	Midnt. 12—1		6	45
<i>April 11—</i>				<i>April 12—</i>			
1—2	1	2	0	1—2 A.M.	1	2	15
2—3	1	1	30	2—3		7	0
3—4	1	2	0	3—4	1	4	55
4—5	1	0	20	4—5	1	4	45
5—6	1	1	15	5—6	2	0	35
6—7		6	0	6—7	1	5	10
7—8	1	0	0	7—8	2	0	0
8—9	1	3	30	8—9	2	1	30
9—10	1	4	0	9—10	1	6	0
10—11	1	3	25	10—11	1	6	0
	30	7	55		39	4	25

Bile Flow for 24 Hours,
without Iridin.

Bile Flow hourly before.

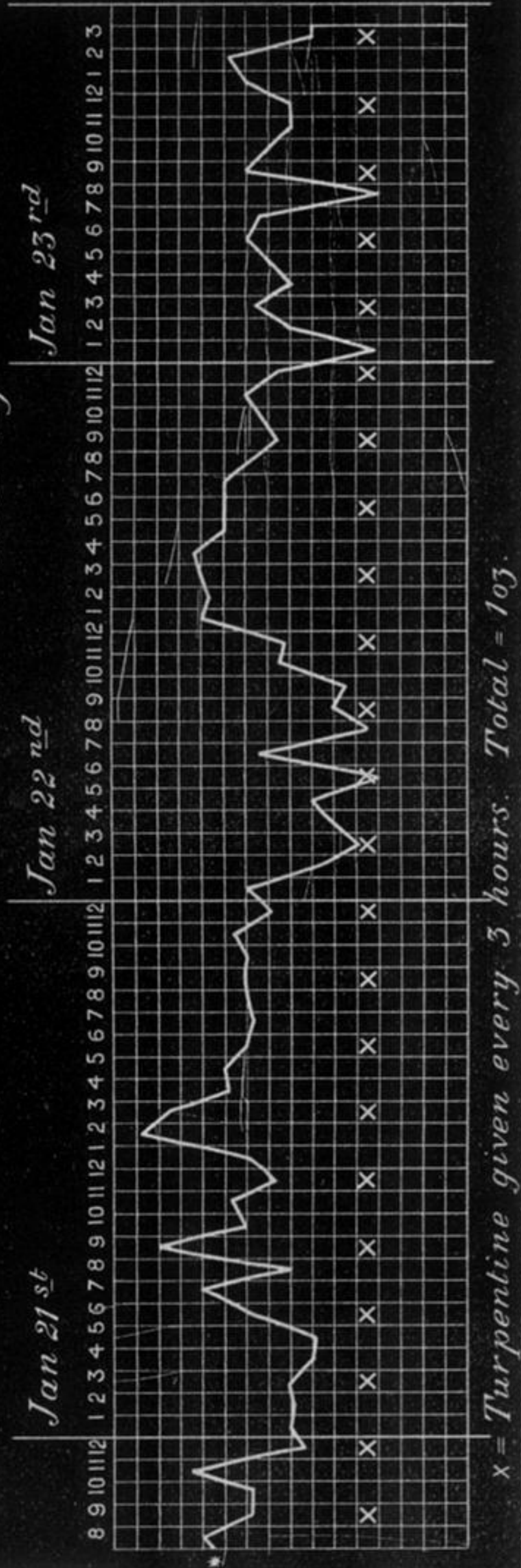
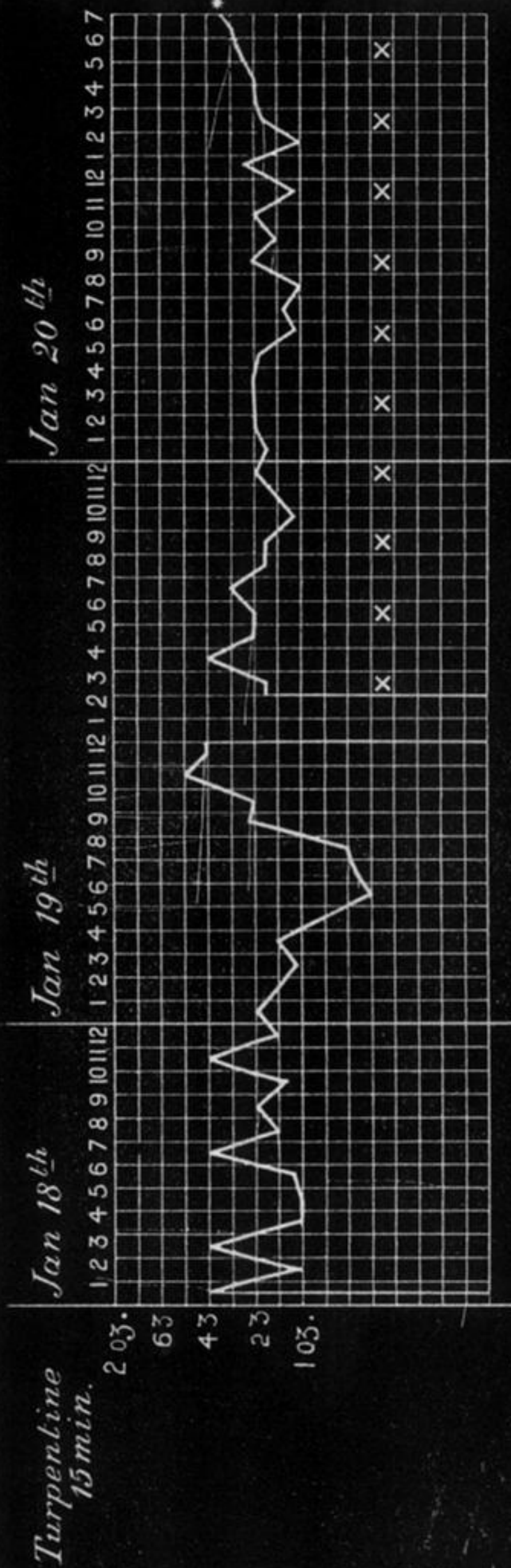
	<i>April 13—</i>				<i>April 16—</i>		
	oz.	dr.	min.		oz.	dr.	min.
10—11 A.M.	2	0	0	..	*1	0	0
11—12	2	0	0	..	1	0	0
Noon 12—1 P.M.	2	1	15	..	1	2	0
1—2	2	0	0	..	1	4	0
2—3	1	6	0	..	2	2	30
3—4	2	2	0	..	2	0	0
4—5	2	0	0	..	1	7	0
5—6	1	6	0	..	2	0	0
6—7	1	5	0	..	2	1	0
7—8	1	0	50	..	2	0	0
8—9	1	4	0	..	1	7	0
9—10	1	4	0	..	2	0	0
				<i>April 15—</i>			
10—11	6	35		oz. dr. min.	20	7	30
11—12	6	45		1 1 15			
				1 2 0			
				<i>April 14—</i>	<i>April 16—</i>		
12—1 A.M.	3	0		6 30			
1—2	1 3 5			2 35			
2—3	1 2 0			6 0			
3—4	5 0			6 0			
4—5	1 0 35			1 1 15			
5—6	6 15			1 6 35			
6—7	1 3 0			1 7 15			
7—8	1 1 10			1 4 0			
8—9	2 1 0			1 2 30			
9—10 A.M.	1 4 0			1 1 0	12	6	55
Total ..	34	7	30	12 6 25	33	6	25

* 10 A.M., iridin, gr. iv.

Presents, April 24, 1890.

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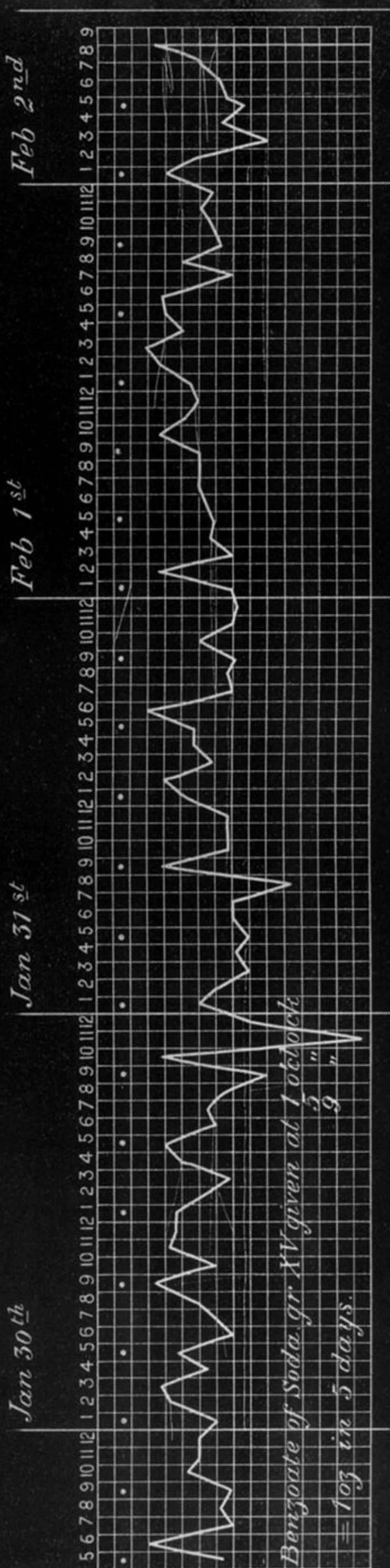
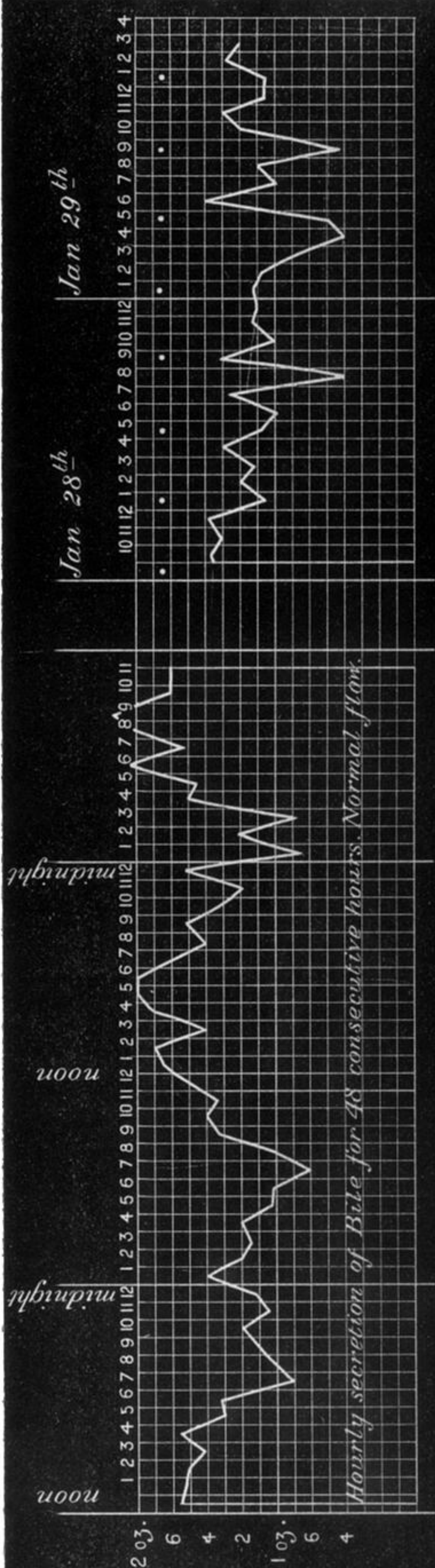


CHART 3.

